

CLAIMS

What is claimed is:

1 1. An apparatus for reducing the parachuting of a probe measuring the
2 topography of a surface comprising:
3 an oscillating probe; *(10) probe*
4 a phase detection circuit coupled to the oscillating probe; and *(10) phase detection circuit*
5 a probe drive boosting circuit coupled to the phase detection circuit and the probe,
6 wherein the phase detection circuit detects a reduction of a variation of a phase
7 signal from the probe and the probe drive boosting circuit boosts a signal to
8 the probe based on the phase signal detected by the phase detection circuit to
9 produce a boosted probe drive signal.

1 2. The apparatus according to claim 1, wherein the phase detection circuit
2 comprises:
3 a precision full wave rectifier; and
4 an envelope detector coupled to the precision full wave rectifier,
5 wherein the precision full wave rectifier rectifies a phase signal of the probe to
6 produce a rectified phase signal and the envelope detector detects the
7 rectified phase signal to produce an envelope detected signal.

1 3. The apparatus according to claim 2, wherein the phase detection circuit
2 further comprises:
3 a comparator coupled to the envelope detector; and
4 an event detector and hold off circuit coupled to the comparator,
5 wherein the comparator and the event detector and hold off circuit generate an event
6 signal from the envelope detected signal.

1 4. The apparatus according to claim 3, wherein the phase detection circuit
2 further comprises a multiplier coupled to the event detector,
3 wherein the multiplier combines the event signal with a probe drive signal to
4 produce the boosted probe drive signal.

1 5. The apparatus according to claim 3, wherein the phase detection circuit
2 further comprises:
3 a multiplier coupled to the event detector; and
4 a control module, wherein the multiplier combines the event signal with a gain
5 setting in the control module to increase error integration.

1 6. The apparatus according to claim 4, further comprising an event level setting
2 circuit coupled between the event detector and hold off circuit and the multiplier, wherein
3 the event level setting circuit sets an event level of the event signal.

1 7. The apparatus according to claim 4, wherein the boosted probe drive signal
2 is boosted 20 to 30 percent of the probe drive signal above the probe drive signal.

1 8. The apparatus according to claim 3, wherein the event detector and hold off
2 circuit delays the generation of the event signal for a predetermined time.

1 9. A method for reducing the parachuting of a probe obtaining accurate
2 information representative of a surface of a sample comprising:

3 scanning the surface of the sample with an oscillating probe;
4 detecting a reduction of a variation of a phase signal of the probe indicative of free
5 oscillation of the probe; and
6 reducing a distance between the probe and the sample in response to the detection of
7 the reduction of the variation of the phase signal of the probe.

1 10. The method according to claim 9, wherein the detecting step further
2 comprises:
3 rectifying the phase signal of the probe to produce a rectified phase signal; and
4 envelope detecting the rectified phase signal of the probe to produce an envelope
5 detected phase signal of the probe.

1 11. The method according to claim 9, wherein the reducing step further
2 comprises boosting a drive signal of the probe to produce a boosted drive signal of the
3 probe.

4 12. The method according to claim 11, wherein the detecting step further
5 comprises triggering an event signal based on the detected phase signal and the boosting
6 step further comprises boosting the drive signal of the probe by combining the event signal
7 with the drive signal of the probe to produce a boosted drive amplitude signal.

1 13. The method according to claim 12, wherein the detecting step further
2 comprises delaying the triggering of the event signal for a predetermined time.

1 14. The method according to claim 11, wherein the boosted drive signal is 20 to
2 30 percent of the drive signal above than the drive signal.

1 15. The method according to claim 9, further comprising:
2 detecting an error signal of the probe when the oscillating amplitude of the probe is
3 too high; and
4 accumulating the error signal of the probe.

1 16. The method according to claim 9, further comprising:
2 detecting an error signal of the probe when the oscillating amplitude of the probe is
3 too small; and
4 accumulating the error signal of the probe.

1 17. The method according to claim 9, wherein the detecting step detects a
2 reduction of a variation of a phase signal when the phase difference between a sinusoidal
3 drive and a probe response signal is substantially 90 degrees.

1 18. The method according the claim 9, wherein the reducing step further
2 comprises boosting a drive signal of the probe to increase the accumulation of an error
3 signal of the probe.

1 19. An apparatus for reducing the parachuting of a probe measuring the
2 topography of a surface comprising:
3 an oscillating probe;
4 parachuting detection circuitry coupled to the oscillating probe
5 parachuting reduction circuitry coupled to the parachuting detection circuitry,
6 wherein the parachuting reduction circuitry reduces the parachuting of the
7 probe in response to the detection of parachuting of the probe.

1 20. The apparatus according to claim 19, wherein the parachuting detection
2 circuitry comprises a phase detection circuit and the parachuting reduction circuitry
3 comprises a probe drive boosting circuit.